JOURNAL OF ADVANCEMENT IN ENGINEERING AND TECHNOLOGY
Journal homepage: www.scienceq.org/JAET.php
ISSN: 2348-2931 V7I3.06
Research Article Open Access

Determination of the Specific Heat Capacities of car engine oil (Deo Max (DM7)/ 15W-40(oilibya)) and defreins brake fluid (total HBF 4 liquid) at low temperature (26-35^{o}C) by using Calorimeter

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Received: February 21, 2020, Accepted: April 14, 2020, Published: April 14, 2020.

ABSTRACT
The purpose of this study is to determine the specific heat capacities of car oils at low temperature (26-35oC). I used experimental method, setting my procedure and analysis the data by using excel and draw graphs by using MATLAB. I used water as the standard mean that first I tried to determine the specific heat capacity of water using colorimeter which is 4184J/kg oc but I determined 4020J/kg oc which is an error around 3.91% this has right to continue my experiment to the next oils by using the same ways. I obtained the specific heat capacity of Deo max 7 and HBF 4 is 4.4736 and 6.8556 J/kgoc respectively. Not all engine oils are suitable for engines. Owing the specific heat capacity of the oils is very important because increase the performance of engine as it increases temperature.
Keywords: *specific heat capacities, Deo Max (DM7)/ 15W-40(oilibya), HBF 4, temperature, liquids, density*

INTRODUCTION
Specific heat capacity is the amount of heat energy required to raise the temperature of a substance per unit of mass. The specific heat capacity of a material is a physical property. It is also an example of an extensive property since its value is proportional to the size of the system being examined. its SI units is the amount of heat in joules required to raise 1 gram of a substance 1 Kelvin. It may also be expressed as J/kg·K. Specific heat capacity may be reported in the units of calories per gram degree Celsius, too. Related values are molar heat capacity, expressed in J/mol·K, and volumetric heat capacity, given in J/m^3·K.
Heat capacity is defined as the ratio of the amount of energy transferred to a material and the change in temperature that is produced:
C = C /ΔT……1
Where C is heat capacity, Q is the energy (usually expressed in joules), and ΔT is the change in temperature (usually in degrees Celsius or in Kelvin). Alternatively, the equation may be written:
Q = CmΔT……2
Where C is heat capacity, m is the mass of a material, and S is specific heat. Note that since specific heat is per unit mass, its value does not change, no matter the size of the sample. So, the specific heat of a gallon of water is the same as the specific heat of a drop of water. [1]
While engine oil lubricates and mitigates Iar, it importantly serves as a heat-transfer fluid in engines. Oil thermal conductivity and specific heat are important parameters for engine cooling system design, and are a function of temperature. Oils with a larger thermal conductivity value will transfer heat energy more efficiently. Oils with a larger specific heat value will have a smaller temperature rise for a given amount of heat energy absorption. The heat transfer properties of lubricants for low heat rejection (LHR) diesel engines are particularly important. The external oil cooler and radiator will not be present in proposed uncooled LHR engines. The engine oil would be the sole heat transfer fluid. Current LHR engine oils are formulated with Group V base fluids, whose heat transfer properties have not previously been determined.[2]
The lubricating and cooling capacities of different SAE 20W-50 multi grade engine oil samples Ire examined in terms of specific heat capacities and cooling rates. Out of the five samples of oil coded as A, B, C, D and E, of them have very close related values of cooling rates while only B, has a bright-line distinction with a characteristically high cooling rate. Sample E of the multi grade oil samples examined also has the highest specific heat capacity which is suggestive of the high internal energy stored in the lubricating system. The multi grade oil with higher cooling rate is the best coolant and lubricator and the oil sample with highest specific heat capacity has high internal energy that is inversely proportional to viscosity. High energy and less viscous sample (E) lubricates better and starts engines faster than other samples which may have low internal energies and high viscosities when compared with sample E.[3]
The thermal properties of engine oil are important traits affecting the ability of the oil to transfer heat from the engine. The larger the thermal conductivity and specific heat, the more efficiently the oil will transfer heat. In this work, I measured the specific heat of oil-based diesel engine lubricant and total HBF 4 liquid de-freins brake fluid with Water.

Photo -1 DeoMax and total HBF 4 oil

1.1. Objective
- To determine the specific heat capacity of Deo Max (DM7)/ 15W-40(oilibya) and total HBF 4 liquid defreins brake fluid
- Characterized them using its density before and after experiments

- To show graphically the relationship between time vs temperature using MATLAB

1.2. Method

2. EXPERIMENTAL

2.1.1.1. **Materials:**

- Deo Max (DM7) samples, HBF 4 liquid defreins brake, and water in addition to calorimeter setup

1.3.1.2. Procedure (Steps to determine the specific heat capacity).

1. Measure (100-105) g of Deo Max HBF 4 liquid/ defreins brake (m_w /m_o).
2. Then measure the mass the inner container of the calorimeter (MC) and (100-105) g of oil/water into it.
3. Connect the heating coil into the circuit the DC voltage , Ammeter and voltmeter and heating coil
4. With the power supply still off, choose such combination of voltage and resistance of the coil so that the electrical current in the circuit is about 2A (Connect a 24V DC power supply.)
5. Before turning the power supply on measure the temperature of oil/water in calorimeter; leave the thermometer in the calorimeter during the whole measurements.
6. Turn off the power supply and at the same begin to measure the time of the heating. Also take notes of voltage and current values.
7. After about 3minutes turn the power supply off, quickly stir the oil/water with a stirrer and read the final temperature of the water.

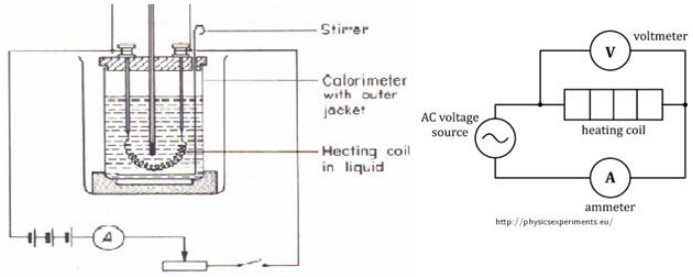

Figure 1 the specific heat capacity setup (electrical Method)

2.2. **Data table**

		Data for water / Data for DM7 / HBF 4			
time (in minutes)	temperature (^{o}c)	Current (in Ampere)	voltage	$\Delta T=T_f-T_i$	
0					
3					
3					
3					
3					

Table 1data table

2.3. Result and discussion

- By using MATLAB draw graphs and calculate analytical

I . The Specific Heat Capacity Of Water

m/ no	**Temp (^{o}C)**	**Current (A)**	**Voltage (V)**	**Time (s)**	**Mass Water(kg)**	**ΔT**	**v*I*ΔT**	**MC*cc *ΔT**	**v*I*ΔT - MC*cc *ΔT**	**M_w*Δ T**	**(v*I*Δ T- MC*cc *ΔT)/ m*ΔT**
1	26	2.48	26	180	0.102	1	11606	295.68	11310. 72	2.652	4265.0
2	27	2.4	26	190	0.103	1	11955	295.68	11659. 12	2.781	4192.4
3	28	2.4	26	185	0.103	1	11688	295.68	11392.	2.884	3950.3

									62		
4	29	2.4	26	195	0.102	0	12320	0	12320.1	2.958	4165.0
5	29	2.5	26	210	0.103	0	13541	0	13540.8	2.987	4533.2
6	29	2.4	26	200	0.104	-29	12636	-8575	21210.72	3.016	7032.7
average of the C of water = $\frac{v*I*\Delta T - MC*cc*\Delta T/m*\Delta T}{6}$ = **4019.8J/kg ^{o}C(4.02J/g^{o}c)**											4019.8

Table 2 specific heat capacity of water

The above table 2 shows that the experimental value the specific heat capacity of water is around 4.02.The true value of the specific heat capacity of water is 4.186 (this value is truth value).

%error= $\frac{\text{truth value} - \text{expermental value}}{\text{true value}}$ *100=3.91% (error) which is acceptable because less than (5-10) %. This shows I have a confidence to continue to the next two liquids (water as a standard). In some cases, the measurement may be so difficult that a 10% error even higher may be acceptable. Other case, a 1% error may be too high. Most university instructors will be accepting an error less than 5%. But this is only a guideline. When I observing my experiment the specific heat capacity is as shown above which is error is less than 5% so it can be acceptable on the range.

II. THE SPECIFIC HEAT CAPACITY OF DEOMAX (DM7)

m/t no	Temp (^{o}C)	current(A)	Voltage (V)	Time (s)	Md (kg)	ΔT	v*I*ΔT	MC*cc*ΔT	v*I*ΔT-MC*cc*ΔT	m*ΔT	(v*I*ΔT-MC*cc*ΔT)/m*ΔT
1	33	2.44	26.1	180	0.081	-1	11463	-295.7	11758.8	2.673	4399.1
2	32	2.47	26.1	190	0.083	-1	12249	-295.7	12544.41	2.656	4723.1
3	31	2.43	26.1	185	0.083	2	11733	591.36	11141.895	2.573	4330.3
4	33	2.44	26.1	195	0.082	-1	12418	-295.7	12714.06	2.706	4698.5
5	32	2.43	26.1	210	0.085	1	13319	295.68	13023.15	2.72	4787.9
6	33	2.42	26.1	200	0.081	-33	12632	-9757	22389.84	2.673	8376.3
Average of the C of Deo Max 7=4473.6											4473.6

Table 3 the specific heat capacity of deo max7

The above table 3 shows that specific heat capacity of deo max (DM7). The specific heat capacity of deo max oil is 4.4736J/kg ^{o}c . In my believe this is the first. This average value is my experimental value. There is no known value of the specific heat capacity of Deo max oil.

As known to all, the main function of oil is to reduce friction of moving parts; moreover it helps clean, prevents corrosion, enhances sealing, and cools the moving parts of the engine. Engine oil helps engine cooling the important parts of engine, like piston assembly,

iii . the specific heat capacity of HBF 4

m/t no	Temp (^{o}C)	current (A)	Voltage (V)	time(s)	mw	ΔT	v*I*ΔT	MC*cc*ΔT	v*I*ΔT-MC*cc*ΔT	m*ΔT	(v*I*ΔT-MC*cc*ΔT)/m*ΔT
1	30	2.49	26.1	180	0.031	2	11698	591.36	11106.66	0.93	11942.6
2	32	2.49	26.1	190	0.041	1	12348	295.68	12052.23	1.312	9186.2
3	33	2.5	26.1	185	0.051	1	12071	295.68	11775.57	1.683	6996.8
4	34	2.45	26.1	195	0.061	-1	12469	-295.7	12764.955	2.074	6154.8
5	33	2.44	26.1	210	0.071	2	13374	591.36	12782.28	2.343	5455.5
6	35	2.5	26.1	200	0.081	-35	13050	-10349	23398.8	2.835	8253.5
Average of the C of HBF 4=6855.6											6855.6

Table 4 the specific heat capacity of HBF4

Table 4 indicates that the specific heat capacity of hbf4 is 6.8556j/kg ^{o}c, this value is my experimental value. There is no known value of specific heat capacity for hbf 4 oil. As the science explains that in combustion engines, engine oil fulfills some purposes. One of the most important of these is to lubricate mechanical components. Lubrication reduces friction between moving parts and keeps a minimum. Engine oil also has to cool, clean, provide protection against corrosion and seal combustion chambers.

IV. DENSITY OF WATER, DEO MAX 7 AND HBF4 BEFORE AND AFTER EXPERIMENT

Density is one of the characteristics or properties to figure some liquid. I know that the density of water is 1g/cm^3.Before the experiment but after the experiment I had 0.96 g/cm^3. I have the value 0.8251g/cm^3 for Deo max and after experiment around 0.762g/cm^3.

Density of engine oils is a function of engine operating temperature. It's known fact that density of lubricating oil decreases with rise in temperatures. The research work of F.Jian et al., [4].

When the oil used in an engine it undergoes a burning experiences due to heat associated with combustion inside the vehicle engines, this will change the characteristics. Like this the density of HBF 7 before and after the experiment is 0.732 g/cm^3 and 0.980 g/cm^3 respectively.

Density of Deo Max Oil

No	Before experiment		ρ (g/ml)	After experiment		ρ (g/ml)
	M(g)	V(ml)		M(g)	V(ml)	
1	81	100	0.81	81	106	0.764
2	83	100	0.83	83	109	0.761

3	83	100	0.83	83	107	0.775
4	82	100	0.82	81	108	0.75
5	85	100	0.85	84	110	0.763
6	81	100	0.81	82	108	0.759
			0.825			0.762

Table 5 Density of Deo Max

Density of HBF 7 Oil

No	Before experiment		ρ (g/ml)			After experiment
	M(g)	V(ml)			M(g)	
1	31	50	0.62	32	52	0.615
2	41	60	0.683	41	55	0.745
3	51	70	0.728	51	53	0.962
4	61	80	0.762	61	57	1.07
5	71	90	0.789	72	62	1.16
6	81	100	0.81	80	60	1.33
			0.732			0.980

Table 6 Density of HBF 7 Oil

1.6 Graphical representation

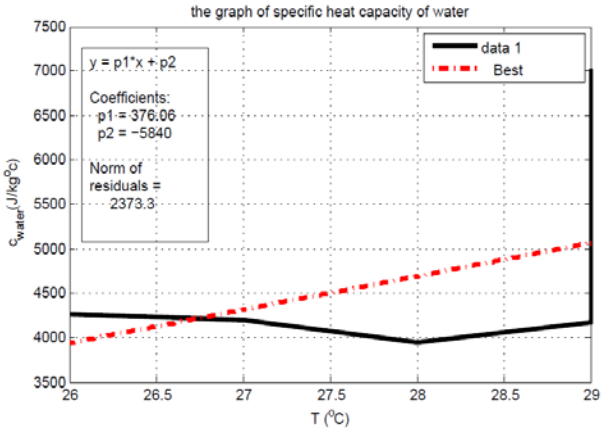

Figure 1 is the summary of the specific heat capacity obtained for different temperature. And shows if data point (solid line) is far from the best fitting line (broken line) then the error is maximum. Again this graphs shows the best fitting line intersect the data line around 26.75°C which is 4200J/kg°c. At constant temperature the specific heat capacity increases i.e at the temperature 29°C the specific heat capacity in incredible high.

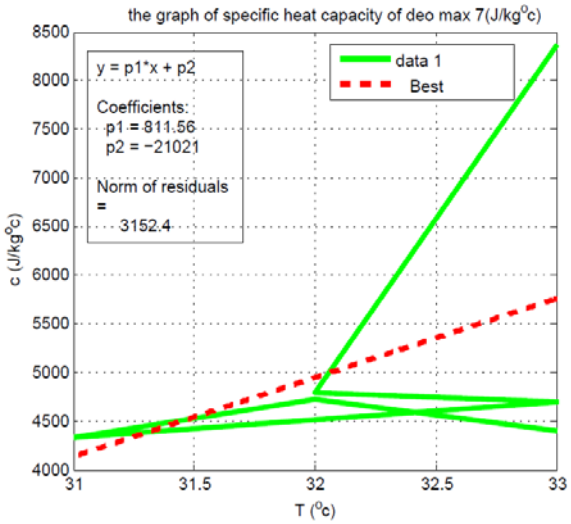

Figure 2 a little bit different around the temperature 31.125oC the specific heat capacity is around 4125J/kgoc. But betIen 32 and 33oc the value is far from the best fite line (broken Line).

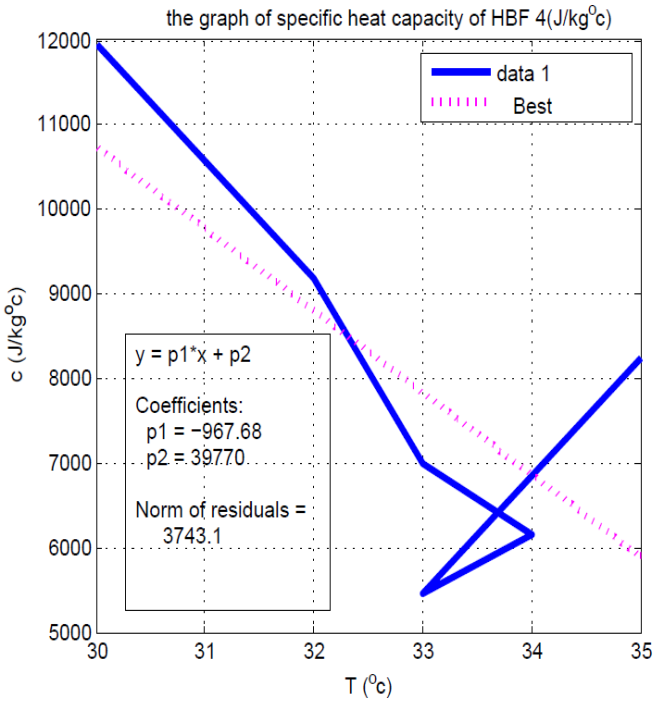

Figure 1 the specific heat capacity of HBF 4

As figure 3 shown the best solution for algorthisms is that the error is very low, so that the temperature betIen 33 to 34 °c shows new property that I maight made an error .but it decreases as the temperature increases up to 22°c but 33oc to 35 °c the specific heat capcity increasing as the temperature increases.The intersection betIen the broken line with the solid line that point is the true value which is around 32.1°C the value is 8900J/kg °c for HBF 4.

CONCLUSION

The study shows that, the specific heat capacity of water is 4186J/kg°c which was done before using this as a slandered and then determined the two oils (Deo max 7 and HBF 4). The specific heat capacity of Deo max 7 and HBF 4 are 4.4736 and 6.8556 J/kg°c respectively. Not all engine oils are suitable for engines. Owing the specific heat capacity of the oils is very important because increase the workability of engine as it increases temperature. There by, such oil becomes poor lubricant at that temperature. The viscosity oil sample at higher temperature is a good parameter for the selection of proper engine oil that can enhance the lifespan of water craft engines (main and auxiliary).

RECOMMENDATIONS

- I have seen the Manual but using this manual the error was 150% so I was changed this as much as possible.
- I have no AC power supply the university must to buy it.
- The experimental room is not attractive to perform the experiment (not clean, material arrangements Ire not good) so this will have great job for department head and teachers.

REFERENCES

1. Dr. Helmenstine holds a Ph.D. in biomedical sciences and is a science writer, educator, and consultant. She has taught science cmyses at the high school, college, and graduate levels.
2. Wrenick, Scott. (2005). Heat Transfer Properties Of Engine Oils. Washington, D.C., USA.
3. N. J George, V. I Obianwu, A. E Akpan and I. B Obot (2010),Lubricating and cooling capacities of different SAE 20W – 50 engine oil samples using specific heat capacity and cooling rate, Nigeria
4. A Mezrhab and M Bouzidi, "Computation of Thermal Comfort," *Applied Thermal Engineering*, vol. 26, no. 14-15, pp. 1697-1704, 2004.

Citation: Getachew Kuma Watiro (2020). Determination of the Specific Heat Capacities of car engine oil (Deo Max (DM7)/ 15W-40(oilibya)) and defreins brake fluid (total HBF 4 liquid) at low temperature (26-35oC) by using Calorimeter. J. of Advancement in Engineering and Technology, V7I3.06. DOI: 10.5281/zenodo.3751590.